

Preservation of the Rocky Beach Blueschist-Eclogite Outcrop, Port Macquarie, NSW as a Geoheritage Reserve

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Small outcrops of blueschist and eclogite occur at Rocky Beach, Port Macquarie, on the NSW mid north coast. These are geologically significant as they represent a unique *in situ* exposure of a rare high-pressure - low-temperature metamorphic sequence not seen elsewhere in Australia. They are also of great educational value to universities, school groups and the general public as they illustrate the effects and consequences of subduction zone processes at depth, now exposed on the surface. Being relatively easily accessible, the site is in danger of destruction by removal of samples and hence should be protected by being listed as a national geoheritage site or included within the nearby Sea Acres National Park.

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INTRODUCTION

The Rocky Beach Metamorphic Melange is located at Port Macquarie on the mid north coast of New South Wales, approximately 400 km north of Sydney (Figure 1a). It covers an area of just under 1 hectare and is locally bound by the Pacific Ocean to the east, Oxley Beach to the north, Flynn's Point headland to the south, and a steep densely vegetated slope to the west, up to the sealed road which provides a buffer from the surrounding residential development on the western side of the road (Figure 1b, 2 and 3).

GEOLOGICAL SETTING

The Rocky Beach Metamorphic Melange forms part of the Port Macquarie Block (Och 2007), located in the eastern part of the southern New England Fold Belt (Figure 1c). It is notable for the presence of well-exposed (?) Early Cambrian to mid-Silurian high-pressure – low-temperature metamorphic rocks

juxtaposed against Late Ordovician ribbon chert, siltstone, sandstone and pillow basalts of the Watonga Formation (Och et al. 2005, 2007) embedded in lenses of mid-Silurian serpentinite melange. Elsewhere along the coastal exposure, to the north and south of Rocky Beach, these rocks are intruded by minor mafic and intermediate calc-alkaline dykes and plutons (Och et al. 2005, 2007).

Similar rocks occur elsewhere in the New England Fold Belt associated with the disrupted boundary between Palaeozoic arc basinal rocks and accretionary subduction zone units. Radiometric dating from scattered localities suggests that the ultramafic protolith of the serpentinites has an age of ~ 530Ma (Aitchison and Ireland 1995). One eclogite phacoid is c.536 Ma (Fanning et al. 2002) and at Port Macquarie, the blueschists were dated by Fukui et al. (1995) using K-Ar at 469 Ma. Recent K-Ar dating of fuchsite from the chlorite-actinolite rind of the Rocky Beach Metamorphic Melange (a reaction rind between the blueschist and eclogite) indicates crystallisation at 427± 8 Ma, therefore defining a hydration age of the ultramafic rock (Och et al. 2010).

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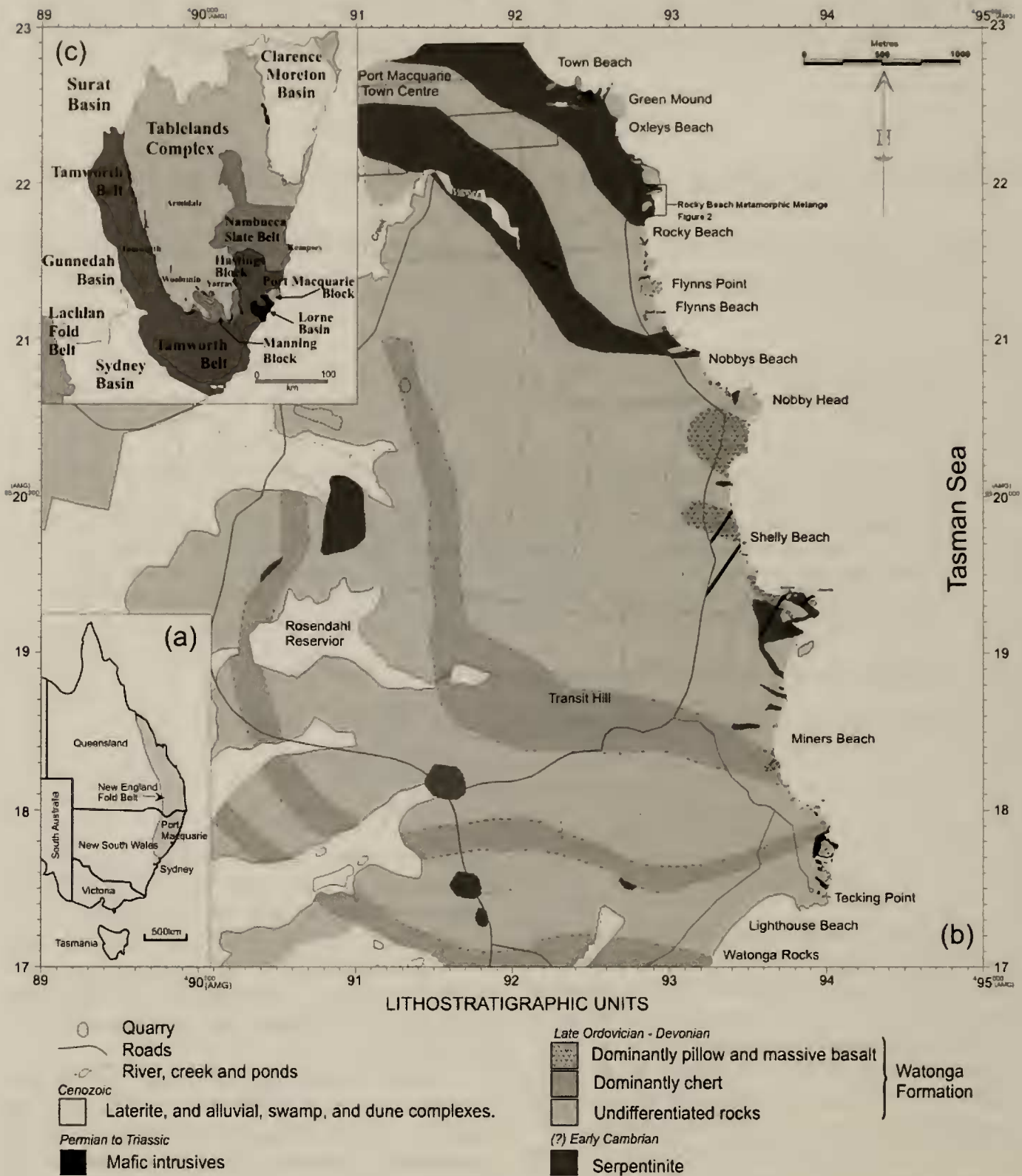


Figure 1 (a) Location of Port Macquarie in the eastern part of the southern New England Fold Belt. (b) Geological map of the northeast corner of the Port Macquarie Block. Map grid is AMG-66. (after Och et al. 2007). (c) The Port Macquarie Block and adjacent tectonic assemblages of the southern New England Fold Belt. Pale grey (Tablelands Complex) is mostly accretionary – subduction complex terranes, grey (Manning Block and Nambucca Slate Belt) Early Permian overlap sequences, and dark grey (Tamworth Belt) Palaeozoic arc and forearc deposits. Widespread latest Carboniferous-Triassic granite bodies omitted.

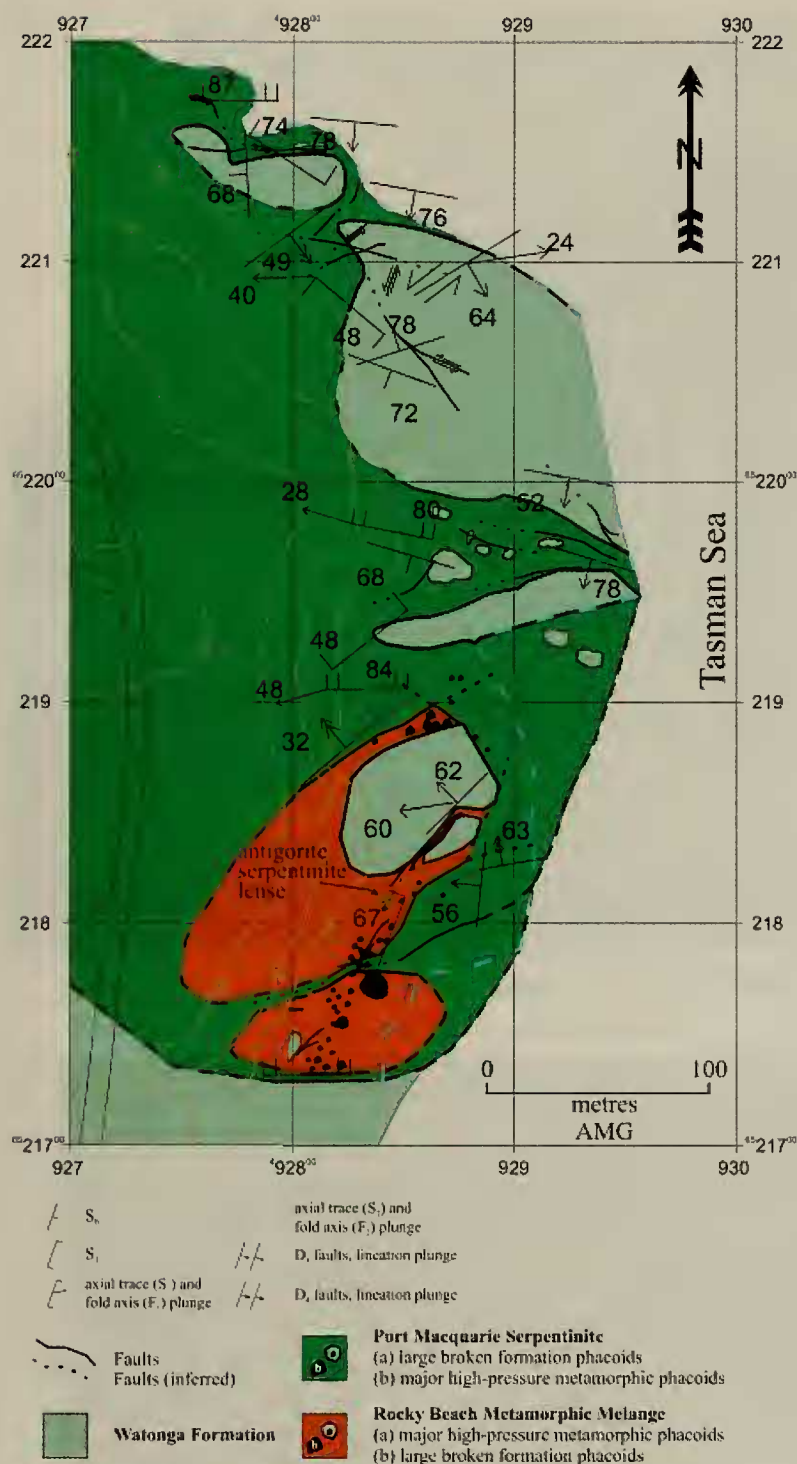


Figure 2 Geological map of the Rocky Beach Coastal outcrop.

LOCAL GEOLOGY

At Rocky Beach (Figure 2 and 3) a ‘melange-in-melange’ structure is preserved and consists of a serpentinite mass that has invaded the Watonga Formation, enveloping two lenses of high-pressure – low-temperature metamorphic rocks that consist of metre-scale phacoids of lawsonite eclogite (Figure 4a and 4b), omphacitite (Figure 5) and glaucophane schist embedded in a chlorite-actinolite schist matrix (Och et al. 2003, 2005, 2007; Och 2007). This exposure

has excellent formational contacts (Figure 5) that demonstrate age relationships that are not observable for similar rock types elsewhere in Australia. The importance of this coastal exposure is the occurrence of a rare high-pressure - low-temperature metamorphic sequence.

DISCUSSION AND CONCLUSION

Geological significance of the Rocky Beach Metamorphic Melange:

- Globally, there are only 10 recorded occurrences of lawsonite eclogite in Phanerozoic orogenic belts (Tsujimori et al. 2006).
- This is possibly the oldest known occurrence, along with a similar occurrence in Spitsbergen in the Arctic.
- Formation and preservation of this sequence requires cold subduction to mantle depths and rapid exhumation.
- The lawsonite eclogite and omphacitite at Rocky Beach are the only occurrences documented in Australia for these rock types.

Social Significance of the Rocky Beach Metamorphic Melange:

- The variety of ancient rocks and excellent exposures along this coastline provide a scientific interest for visitors.
- Ready accessibility of the coastal outcrops have attracted numerous geological visitors, including university undergraduate groups, geological conference excursions, and research scientists from around the world.

Allocating a geoheritage reserve status to this sequence at Rocky Beach would help preserve it for future geology students, researchers and geotourists. As the rocks are very limited in distribution and rare, protection would be achieved with a declaration as an Australian geoheritage site. This would require anyone who requires samples for analysis to obtain necessary permission from the relevant authority (e.g. NSW National Parks and Wildlife Service). To allow for easy access to this site, a staircase and a walkway would need to be constructed from the coastal walk to the beach below with a possible exit staircase at Flynn's Point, also along the coastal walk. Plaques describing distinctive geological units and specific rock types would allow the coastal walk to become a

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Figure 3 The Rocky Beach coastal section looking north at low tide.

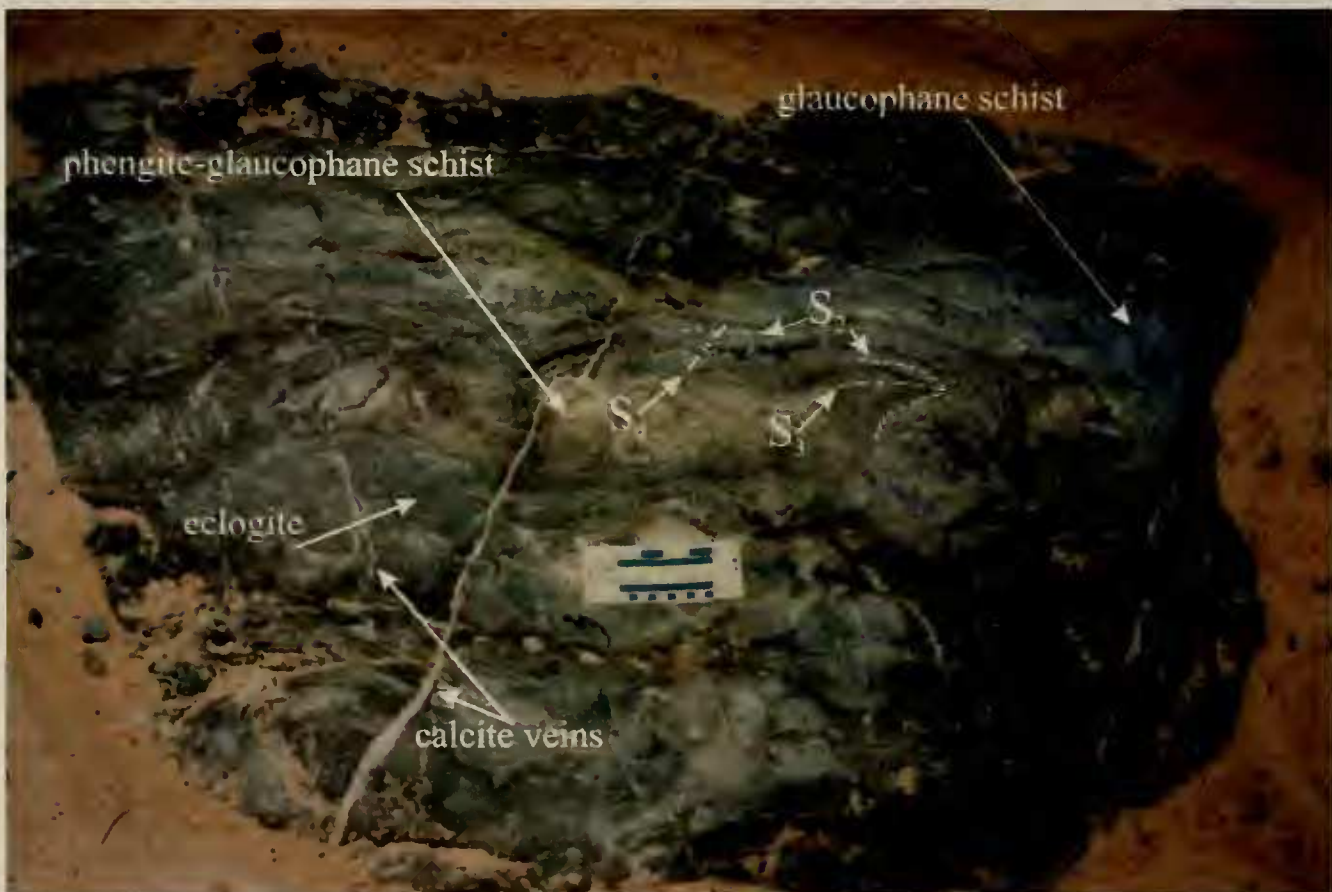


Figure 4A Eclogite phacoid with annotated structural elements (Och 2007), surrounded by sand in the intertidal zone at Rocky Beach (GR 92792178).

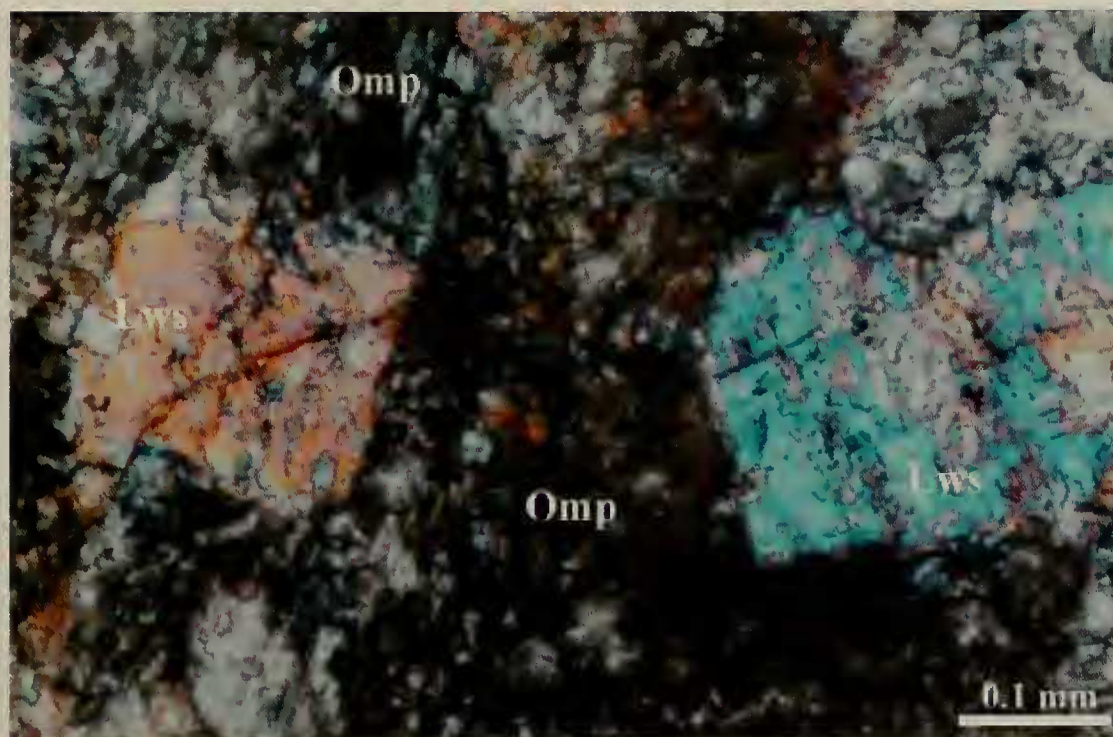


Figure 4B Straight and corroded grain boundaries between omphacite (Omp) and lawsonite (Lws) from eclogite (sample Ptmk432).

geological tourist trail (ie. Town beach, Rocky Beach, Miners Beach and Tacking Point) additionally helping to promote geotourism in the Port Macquarie region.

We believe that allowing access through this area would have a positive impact on the preservation of these rare rock types. The volume of people that would view the geology and detailed signage prohibiting sampling of the outcrops would help stop collectors. The significance of this site to our understanding of the geological evolution of eastern Australia and the extremely rare occurrence of some of these rock types on a global scale would also warrant it being included within an expanded Sea Acres National Park.

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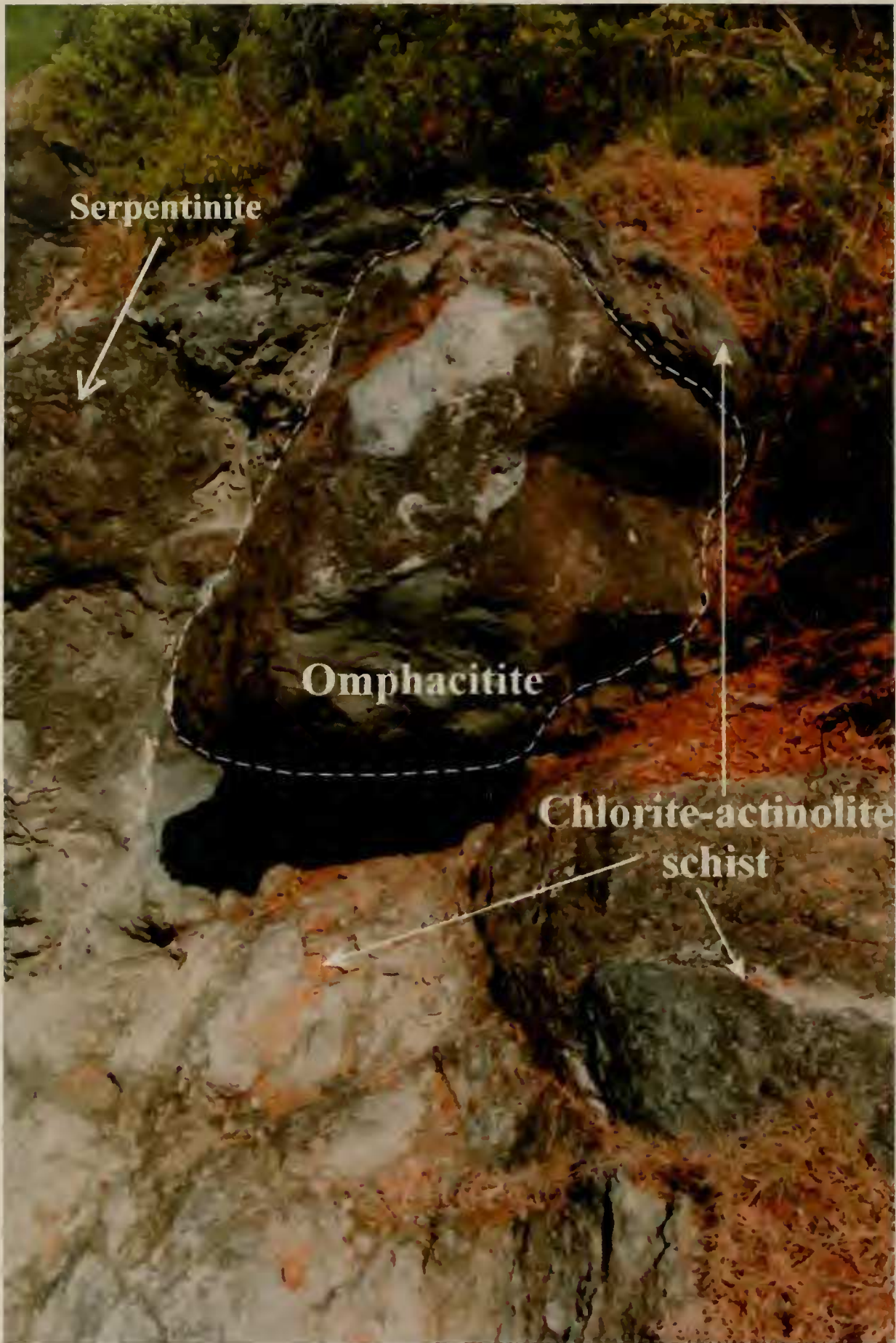


Figure 5 Omphacitite phacoid (outlined) embedded in chlorite-actinolite schist matrix, Rocky Beach Metamorphic Mélange, Rocky Beach (GR. 92812147). Diameter of phacoid is ~ 1.4 m.